In re Patent Application of CALABRO' ET AL.
Serial No. Not Yet Assigned
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## In the Claims:

Claims 1-5 (Cancelled).

6. (New) A method for performing a Shor's quantum algorithm as a function (f(x)) encoded with n qubits, the method comprising:

performing a superposition operation according to the Shor's quantum algorithm over a set of input vectors, and generating a corresponding superposition vector, the performing comprising

calculating as a function of the n qubits a value  $(1/2^{n/2})$  of non-null components of the superposition vector, and

calculating indices (i) of the  $2^n$  non-null components of the superposition vector as an arithmetic succession, a seed of which is 1 and a difference of which is  $2^n$   $(i=1+2^n(j-1))$ ;

performing an entanglement operation on the superposition vector, and generating a corresponding entanglement vector; and

performing an interference operation on the entanglement vector, and generating a corresponding output vector.

7. (New) A method according to Claim 6, wherein performing the entanglement operation comprises:

calculating indices (k) of the  $2^n$  non-null components of the entanglement vector, summing to each term of the arithmetic succession a relative number corresponding to the value of the function (f(j)) calculated based upon a position

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(j) of the term in the the succession (  $k = f(j) + 1 + 2^n(j-1)$ ); and a value of the non-null components of the entanglement vector being equal to the non-null components of the superposition vector.

8. (New) A method according to Claim 7, further comprising generating real and imaginary components of the output vector by performing the following:

for each index h of the real and imaginary components, veryfying whether among terms of the arithmetic succession  $h \mod 2^n + 1 + 2^n (j-1)$  has a seed of  $h \mod 2^n + 1$ , with j being an index and  $2^n$  being a common difference, that there is at least one term corresponding to an index of the non-null component of the entanglement vector; and if the verifying is negative, making the real and imaginary components equal to zero;

otherwise calculating the real component as a product between a value of the non-null components and a summation of the following cosine functions

$$\cos\left(2\pi\frac{(j-1)\cdot\operatorname{int}[(h-1)/2^n]}{2^n}\right)$$
, and

calculating the imaginary component as a product between a value of the non-null components and a summation of the following sine functions

$$\sin\left(2\pi\frac{(j-1)\cdot\inf[(h-1)/2^n]}{2^n}\right)$$

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for all values of the index j of the arithmetic succession in which indices (k) of the non-null components of the entanglement vector correspond thereto.

9. (New) A method for performing a Simon's quantum algorithm as a function (f(x)) encoded with n qubits, the method comprising:

performing a superposition operation according to the Simon's quantum algorithm over a set of input vectors, and generating a corresponding superposition vector, the performing comprising

calculating as a function of the n qubits a value  $(1/2^{n/2})$  of non-null components of the superposition vector, and

calculating indices (i) of the  $2^n$  non-null components of the superposition vector as an arithmetic succession, a seed of which is 1 and a difference of which is  $2^n$  ( $i=1+2^n(j-1)$ );

performing an entanglement operation on the superposition vector, and generating a corresponding entanglement vector;

performing an interference operation on the entanglement vector, and generating a corresponding output vector.

10. (New) A method according to Claim 9, wherein performing the entanglement operation comprises:

calculating indices (k) of the  $2^n$  non-null components of the entanglement vector, summing to each term of the

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arithmetic succession a relative number corresponding to the value of the function (f(j)) calculated based upon a position (j) of the term in the the succession  $(k = f(j) + 1 + 2^n(j-1))$ ; and a value of the non-null components of the entanglement vector being equal to the non-null components of the superposition vector.

11. (New) A quantum gate for performing a Shor's quantum algorithm as a function (f(x)) encoded with n qubits, the quantum gate comprising:

a superposition subsystem for performing a superposition operation according to the Shor's quantum algorithm over a set of input vectors, and generating a corresponding superposition vector, said superposition subsystem

calculating as a function of the n qubits a value  $(1/2^{n/2})$  of non-null components of the superposition vector (P), and

calculating indices (i) of the  $2^n$  non-null components of the superposition vector as an arithmetic succession, a seed of which is 1 and a difference of which is  $2^n$  ( $i=1+2^n(j-1)$ );

an entanglement subsystem for performing an entanglement operation on the superposition vector, and generating a corresponding entanglement vector; and

an interference subsystem for performing an interference operation on the entanglement vector, and generating a corresponding output vector.

12. (New) A quantum gate according to Claim 11,

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further comprising a first memory buffer for storing the value  $(1/2^{n/2})$  and the indices (i).

- 13. (New) A quantum gate according to Claim 11, wherein said entanglement subsystem calculates indices (k) of the  $2^n$  non-null components of the entanglement vector, sums to each term of an arithmetic succession a number corresponding to a value of the given function (f(j)) calculated based upon a position (j) of the term in the succession  $(k=f(j)+1+2^n(j-1))$ ; and a value of the non-null components of the entanglement vector being equal to the non-null components of the superposition vector.
- 14. (New) A quantum gate according to Claim 13, further comprising a second memory buffer for storing the indices (k) of the  $2^n$  non-null components of the entanglement vector.
- 15. (New) A quantum gate according to Claim 13, wherein said interference subsystem generates real and imaginary components of the output vector by performing the following:

for each index h of the real and imaginary components, veryfying whether among terms of the arithmetic succession  $h \mod 2^n + 1 + 2^n (j-1)$  having a seed of  $h \mod 2^n + 1$ , with j being an index and  $2^n$  being a common difference, that there is at least one term corresponding to an index of the non-null component of the entanglement vector; and if the verifying is negative, making the real and imaginary components equal to zero;

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otherwise calculating the real component as a product between a value of the non-null components and a summation of the following cosine functions

$$\cos\left(2\pi\frac{(j-1)\cdot\inf[(h-1)/2^n]}{2^n}\right)$$
, and

calculating the imaginary component as a product between a value of the non-null components and a summation of the following sine functions

$$\sin\left(2\pi\frac{(j-1)\cdot\operatorname{int}[(h-1)/2^n]}{2^n}\right)$$

for all values of the index j of the arithmetic succession in which indices (k) of the non-null components of the entanglement vector correspond thereto.

16. (New) A quantum gate for performing a Simon's quantum algorithm as a function (f(x)) encoded with n qubits, the quantum gata comprising:

a superposition subsystem for performing a superposition operation according to one of the quantum algorithms over a set of input vectors, and generating a corresponding superposition vector, said superposition subsystem

calculating as a function of the n qubits a value  $(1/2^{n/2})$  of non-null components of the superposition vector, and

calculating indices (i) of the  $2^n$  non-null

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components of the superposition vector as an arithmetic succession, a seed of which is 1 and a difference of which is  $2^n$  ( $i=1+2^n(j-1)$ );

an entanglement subsystem for performing an entanglement operation on the superposition vector, and generating a corresponding entanglement vector; and an interference subsystem for performing an

interference subsystem for performing an interference operation on the entanglement vector, and generating a corresponding output vector.

- 17. (New) A quantum gate according to Claim 16, further comprising a first memory buffer for storing the value  $(1/2^{n/2})$  and the indices (i).
- 18. (New) A quantum gate according to Claim 16, wherein said entanglement subsystem calculates indices (k) of the  $2^n$  non-null components of the entanglement vector, sums to each term of an arithmetic succession a number corresponding to a value of the given function (f(j)) calculated based upon a position (j) of the term in the succession  $(k = f(j) + 1 + 2^n(j-1))$ ; and a value of the non-null components of the entanglement vector being equal to the non-null components of the superposition vector.
- 19. (New) A quantum gate according to Claim 18, further comprising a second memory buffer for storing the indices (k) of the  $2^n$  non-null components of the entanglement vector.